

FUTURE

Modeling and **S**imulation in **H**ealthcare **F**uture **D**irections

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Simulation

Definition

(Oxford English Dictionary)

1. Tendency to assume a form resembling that of something else; unconscious **imitation**.
2. A false assumption or display, a surface resemblance or **imitation**, *of* something.
3. The technique of **imitating** the behavior of some situation or process (whether economic, military, mechanical, etc.) **by means of a suitably analogous situation or apparatus**, esp. for the purpose of study or personnel training.

Simulation

Definition

(Proposed)

Representation of

‘real world’ objects, processes and ideas

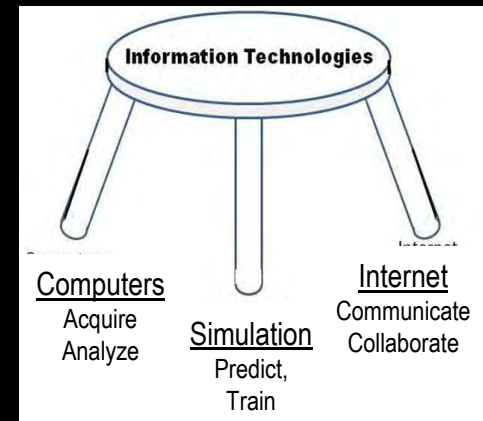
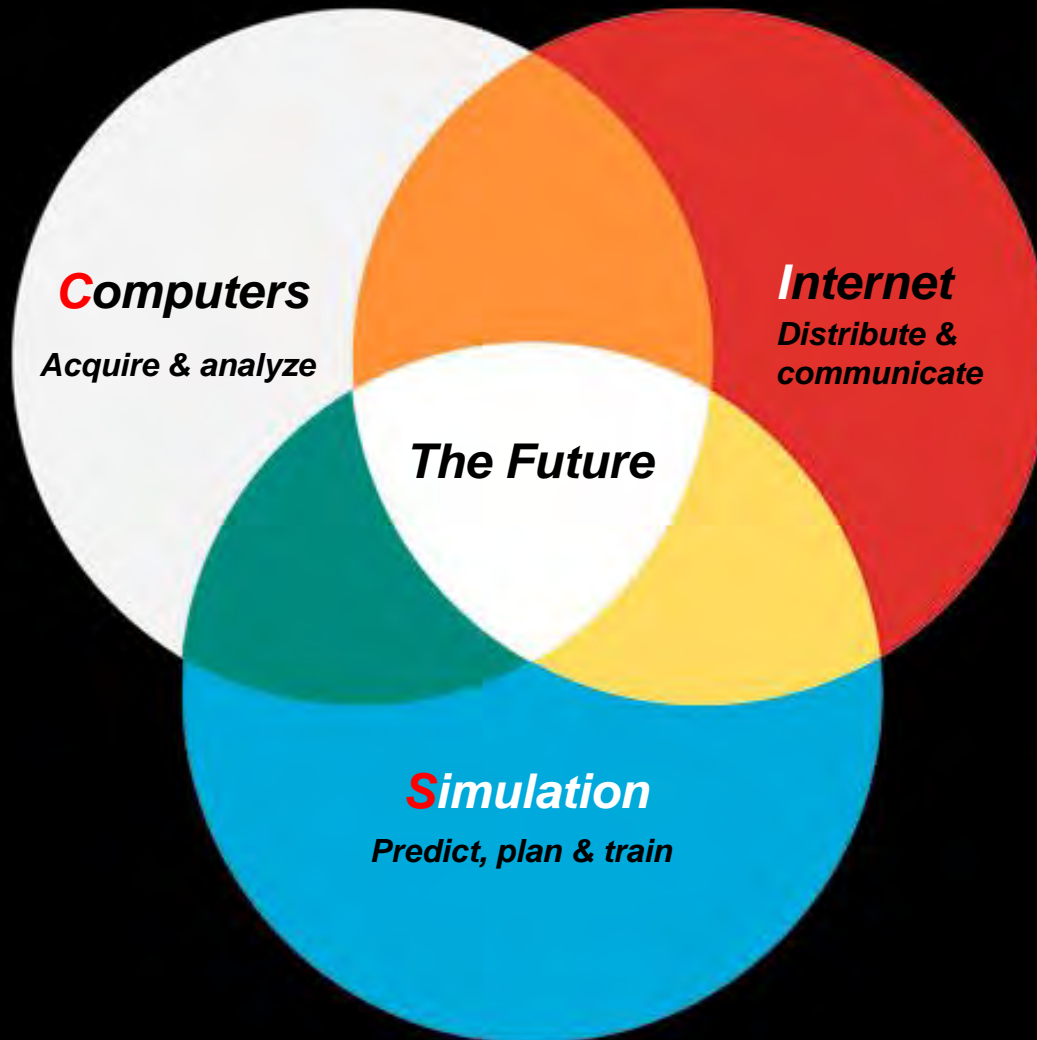
by an

‘intangible world’ of information

all have equal “weight” in the information world

Simulation

Third Leg of the Information Age



The Scientific Method is Dead

Evidence Based Medicine is . . .

**The Scientific Method as
Applied to Medicine**

The Evidence IS the Science

In order to accept evidence-based medicine

. . . we must accept the current method in Science

Scientific Method . . .

. . . is **DEAD?**

Not necessarily but . . .

Not all science is explainable using the scientific method

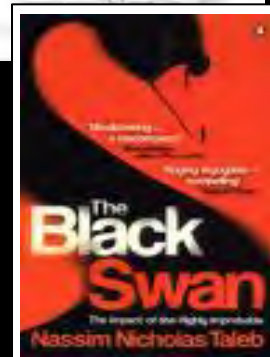
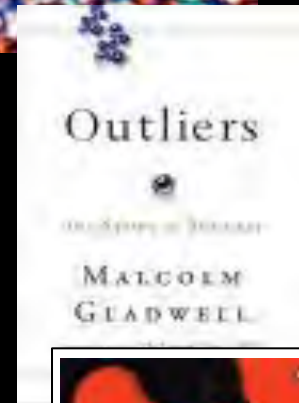
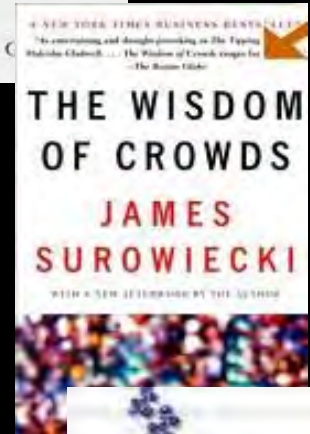
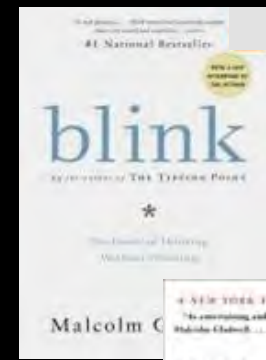
Where is the role of	Imagination	Intuition
	Innovation	Creativity
	Serendipity	Inspiration

FURTHER PROOF: Current evidence is inadequate for

Event horizons	Cognition	Genome
Quantum mechanics	Memes	Etc

New discoveries evolve from

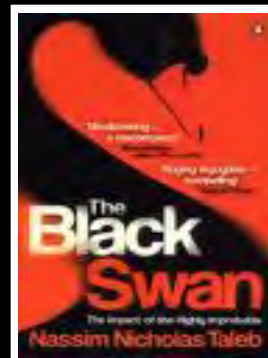
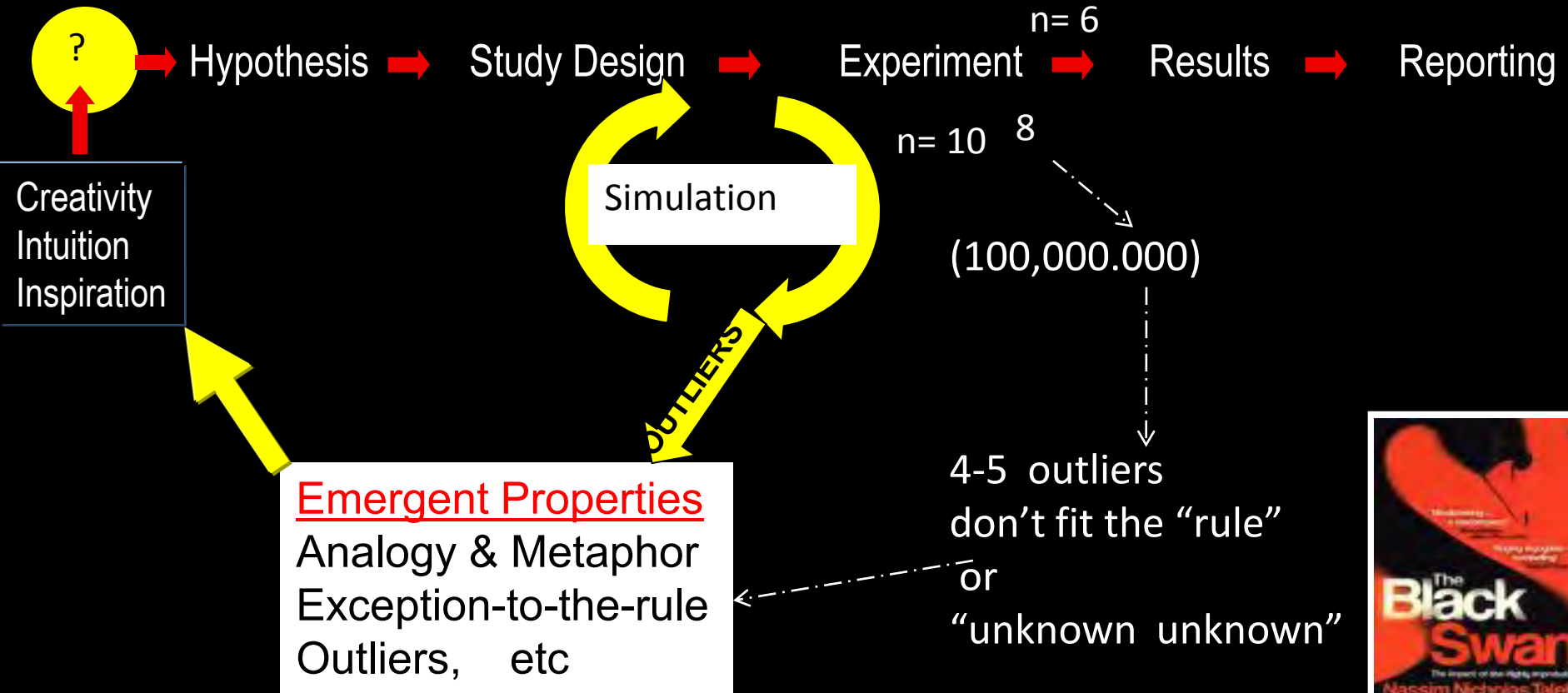
Emergent Properties



How has the Scientific Method changed ?

Hypothesis → Study Design → Experiment ⁿ⁼⁸ → Results → Reporting

Simulation



Modeling and **S**imulation **H**ealthcare **A**pplications

1. Education and training (technical and cognitive skills, distributed learning)
2. Healthcare systems (processes and optimization)
3. Fiscal responsibility (financial planning)
4. Clinical practice (procedural planning, surgical rehearsal, warm-up)
5. Patient administration (Quality improvement and patient safety)
6. Hospital network integration (System of Systems Engineering - SoSE)

Healthcare Education

New Information Age Principles

1. Teach how to find information, not to memorize
2. Information needs to be ubiquitous and distributed
3. “Information wants to be free” (no cost – Kevin Kelly, *Wired* magazine)
4. Evidence-based practice is essential, but must be balanced with creativity
5. Quantify performance (Competency - based)
6. Simulate before practice (Digital Libraries)

Classic Education and Examination



What is the **REVOLUTION** in Surgical Education?

Training for New Technical Skills

Halstedian Model: See One, Do One, Teach One



MEDICAL EDUCATION

The Revolution

is

... Now

Roughly 100 year cycles

(1908 – Flexner Report)

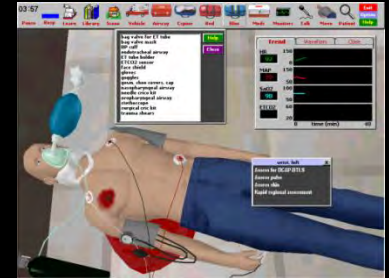
Paradigm Shift

It's all about . . .

Improved Patient Care



Manikin



Virtual Reality

through

Advanced Medical Education

The 6 Competencies

2003 Consensus by the AGCME & ABMS

- Knowledge
- Patient Care
- Interpersonal and communication skills
- Professionalism
- Practice-based learning and improvement
- Systems-based practice

Two Components of the Revolution Using Modeling and Simulation

- Objective Training of Technical Skills
 - Simulators (technology)
 - Curriculum (training method)
- Assessment of Cognitive and Technical Skills
 - Criterion-based tools
 - Objective metrics

Skills Training

The New Mandates

Effective

1 July 2008
RRC*

All residency programs must have
a skills training (simulation) center

1 July 2009
ABS

All surgical residents must pass FLS**
in order to apply for board certificate

* Residency Review Committee (RRC)

Accreditation Council of Graduate Medical Education
Approved by American Board of Medical Specialties

** Fundamentals of Laparoscopic Surgery

It's not the Simulator

It's the Curriculum

Actually, it is the license or certificate

Uses for the Curriculum*

Training

Initial fundamental training (residency, etc)

New procedure

Pre deployment (military)

Re-training*

Maintenance of certification


Admin leave (pregnancy, sabbatical, illness, admin training)

Redeployment (military)

* Retraining curriculum needs to be totally different from initial training - essentially a refresher of known skills

Standardized Curriculum

Suggested template

- 
- Goals of the Curriculum
(include consensus on metrics and initial instructions)
 - Anatomy or Tasks (if basic skills)
 - Steps of the Procedures or skills tasks
 - **Errors** (define and describe how to avoid)

TEST

- Skills Training (on simulator, to benchmark metrics)
- Outcomes assessment* (and results reporting)

* After validation by experts who take the curriculum and finish the Outcomes Assessment, the experts' mean scores become the Benchmark metrics

The 4 “Customers”

WHO USES A CURRICULUM ?

Customer	Role	Purpose
Department Chair	Planner	Develop a program
Faculty	Consumer	Teach the learner
Student	User	Learn to be competent
Licensing Authority	Certifier	Certify* competence

* Hospitals DO NOT use curricula, they use CERTIFICATES that prove their doctors/nurses are competent

Process to Develop a Curriculum

Curriculum Development

Consensus Conference

Develops Outcomes Metrics

Educational Research

Develops Curriculum

Simulator Research

Builds Simulator (to support curriculum)

Validation Research

Proves effectiveness

Training Program

Trains learners (training/retraining)

Testing authority

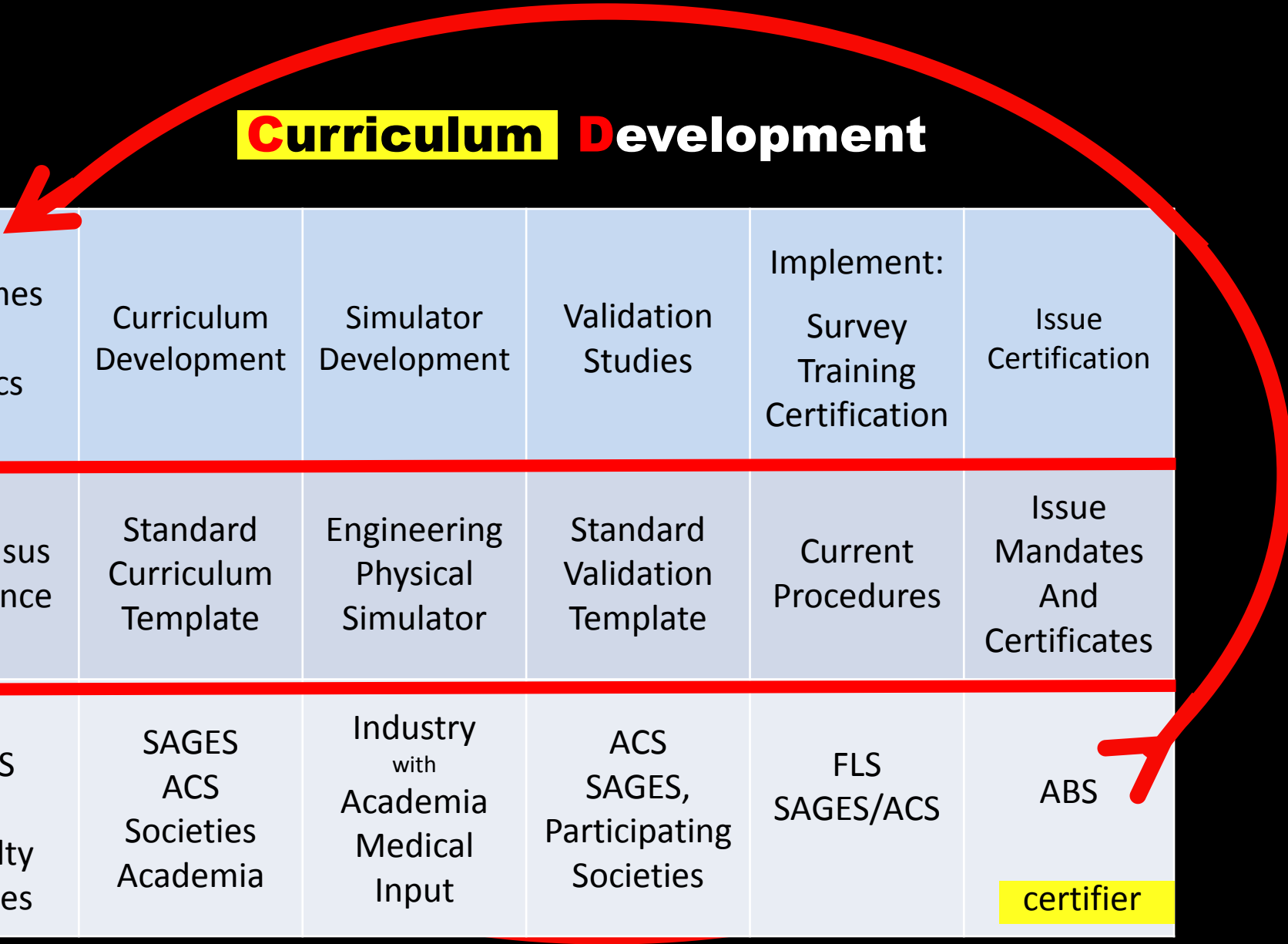
Certifies training

Certifying authority

Certifies competency (and decides mandates)

The Metrics Drives the Process

Curriculum Development



Outcomes & Metrics	Curriculum Development	Simulator Development	Validation Studies	Implement: Survey Training Certification	Issue Certification
Consensus Conference	Standard Curriculum Template	Engineering Physical Simulator	Standard Validation Template	Current Procedures	Issue Mandates And Certificates
ABS SAGES ACS Specialty Societies	SAGES ACS Societies Academia	Industry with Academia Medical Input	ACS SAGES, Participating Societies	FLS SAGES/ACS	ABS certifier

Another **C**oncern

oppportunity

Maintenance of Certification ...

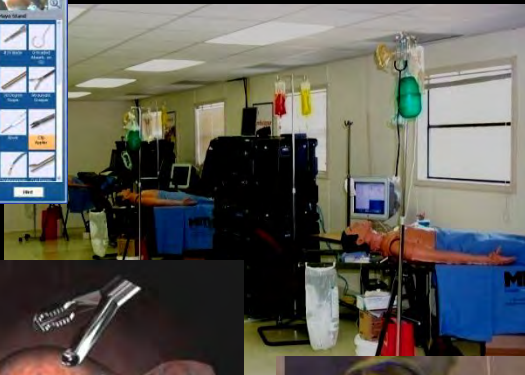
... will be more frequent

Skills **T**raining via **I**nternet

Technology

Current areas of simulation

Models, tissue, animals



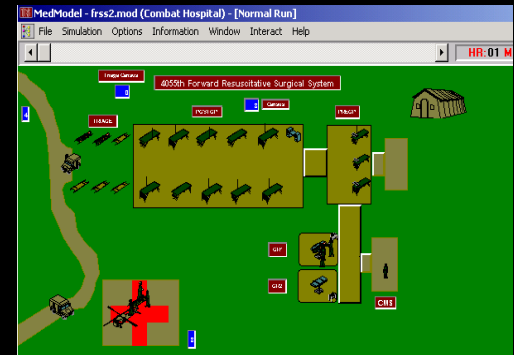
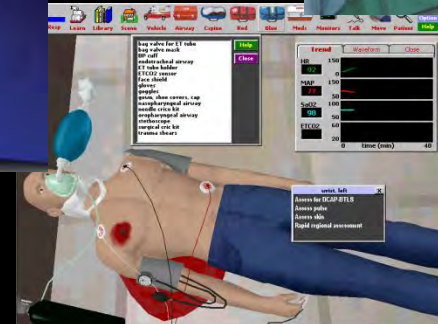
VR



Manikin



CAI



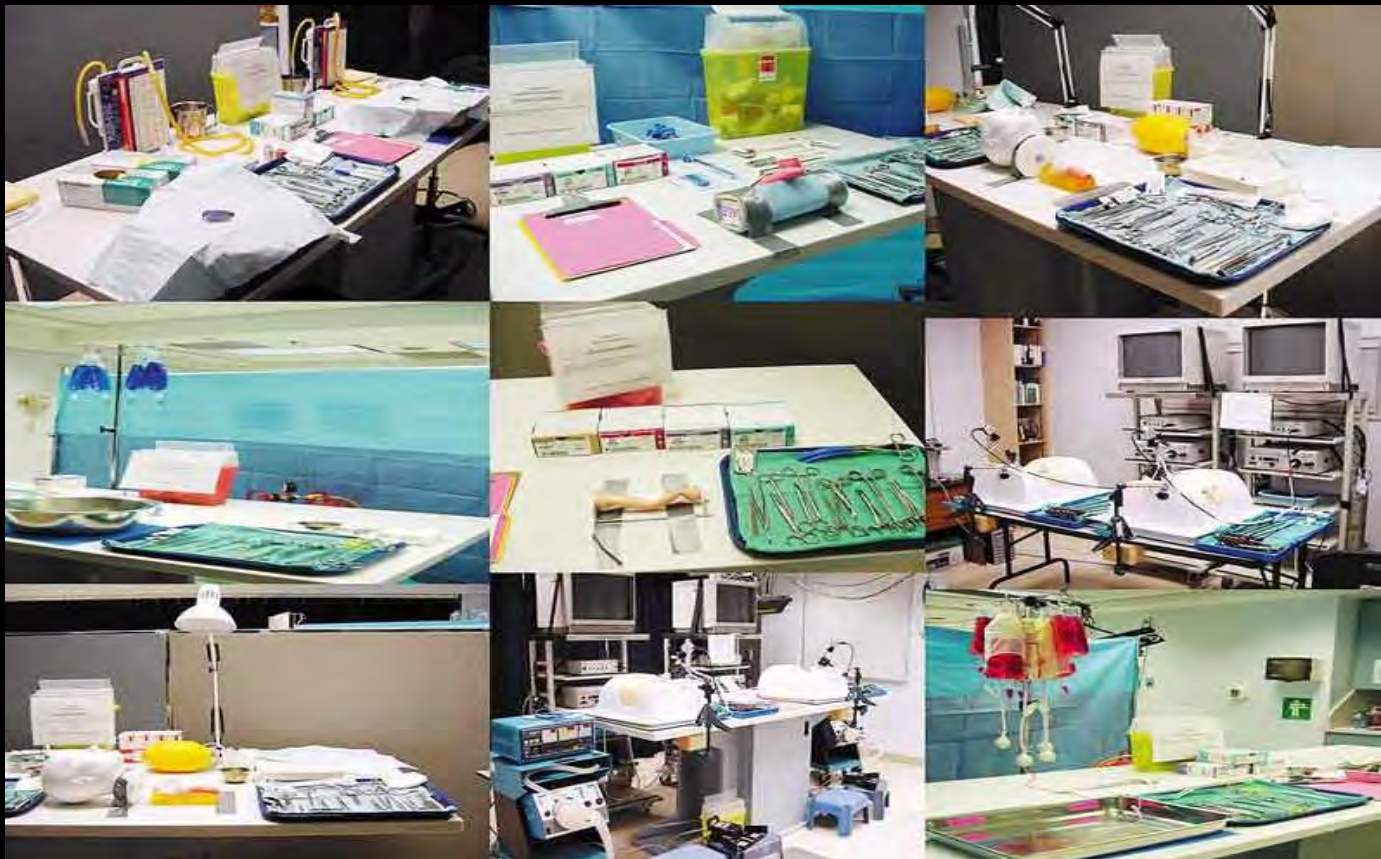
Virtual

Live

Constructive

OSATS Methodology

Objective **S**tructured **A**ssessment of **T**echnical **S**kills



Team Training



Nurses



Residents



In-situ Care



Real Emergency Room

Continuity of Care



ER

Hand-off



OR

Hand-off



ICU

Future

Directions



**What is new in
Technology?**

Skills

Laboratory

OSCE



Patient Actors



Virtual Patients



Virtual Cadaver



Hand-off:

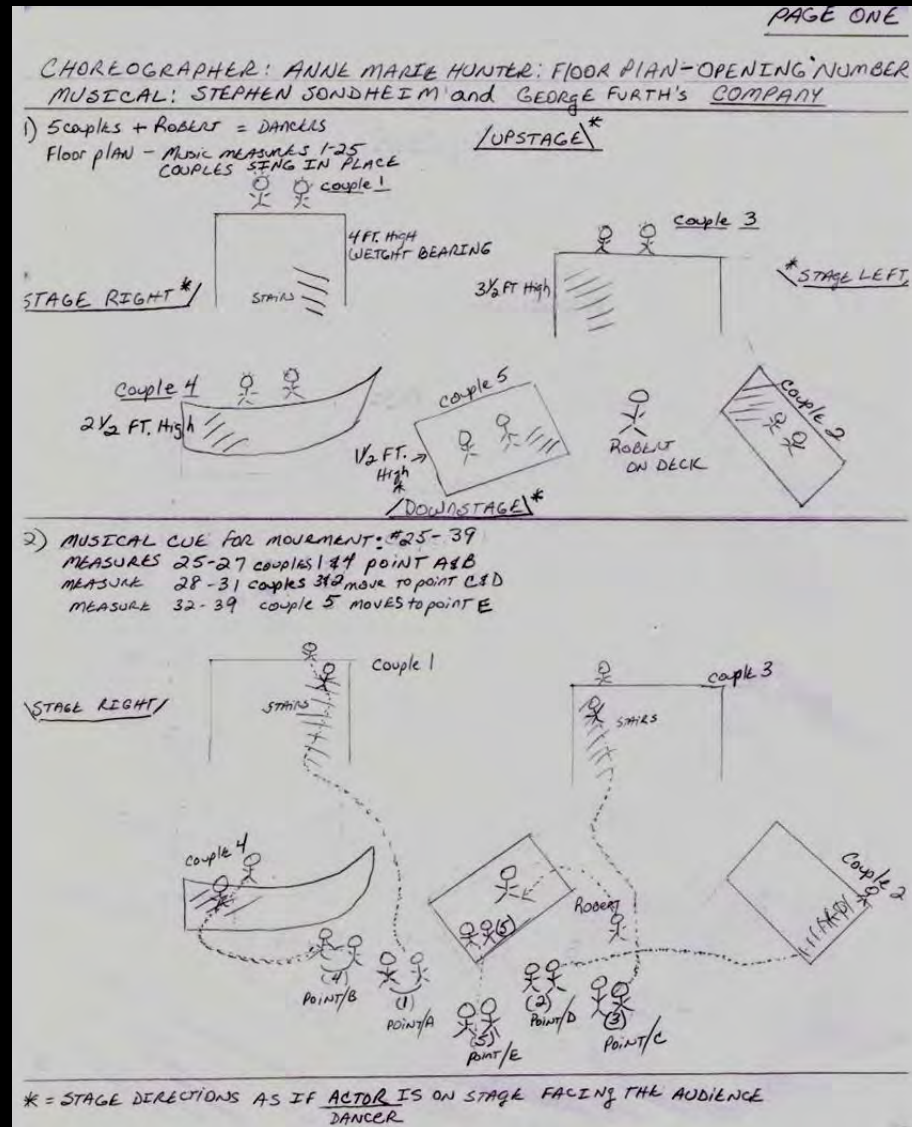
Virtual Hospital Continuity Care

Combat Trauma Training
Chain of Evacuation - (MSTC)
Madigan Army Hospital, Ft. Lewis, WA

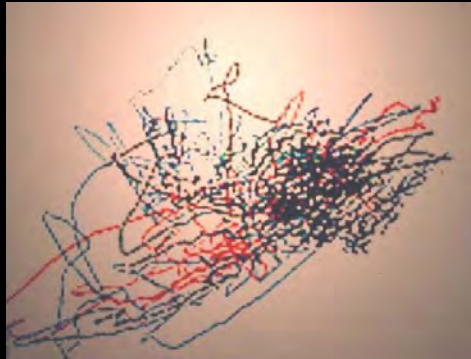
Civilian Hospital Training
Chain of Safety - Riverside Sim Center
Columbus Ohio



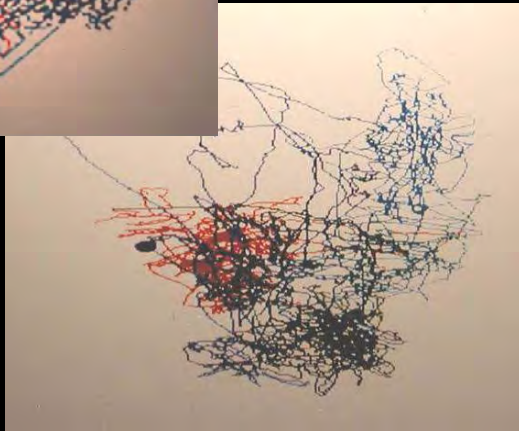
Choreography



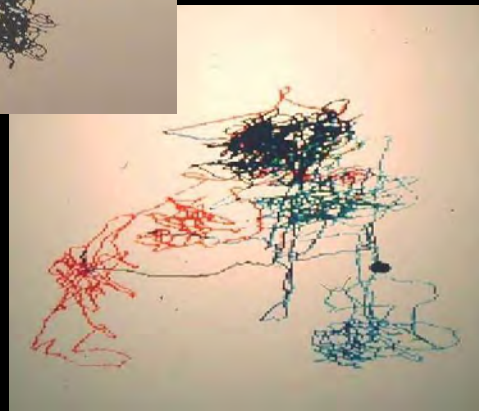
Quantitative Measures



Novice



Intermediate



Expert



"Red Dragon"

Passive
recording
devices



"Blue Dragon"

Cognitive vs Psychomotor

Laparoscopic Cholecystectomy

Introduction Pre Op Operate Post Op Quizzes Assessment Anatomy Errors Instruments Video Review References

Back Next

1. Select Instruments
2. Port Positioning
3. Take Down Adhesior
4. Dissect the Triangle
 - 4.0. Triangle of Cal
 - 4.1 Review Anaton
 - 4.2.1. Dissection W
 - 4.2.2. Dissection w
 - 4.3. Open Window
 - 4.4. Enlarge Windo
 - 4.5. Secure Cystic I
 - 4.6. Review Anatoi
 - 4.7. Triangle Dissec
 - 4.8. Triangle Dissec
5. Prep the Cystic Duct
6. Cholangiogram
7. Secure and Divide Cy
8. Dissect & Divide Cyst
9. Dissect the Gallbladd
10. Retrieval of the Gal
11. Port Site Closure
12. Variations & Special

Assistant

Surgeon

Mayo Stand

- #15 Blade
- 0-braided Absorb. on GU
- 30 Degree Scope
- Atraumatic Grasper
- Bovie
- Clip Applier
- Cholangiogram
- Clin. Forcen

Scope Rotation

4.5. Secure Cystic Duct

Secure the duct to prevent bile and stone spillage from the gallbladder. Select the most common port to gain access to the cystic duct.

RED LLAMA SimPraxis Training Module

Hint



Cognitive vs **P**sychemotor **I**nferring **J**udgment



Can we understand what you are thinking?

Simulation in Social Networking

My Space

You Tube

Multi-user video games

Second Life



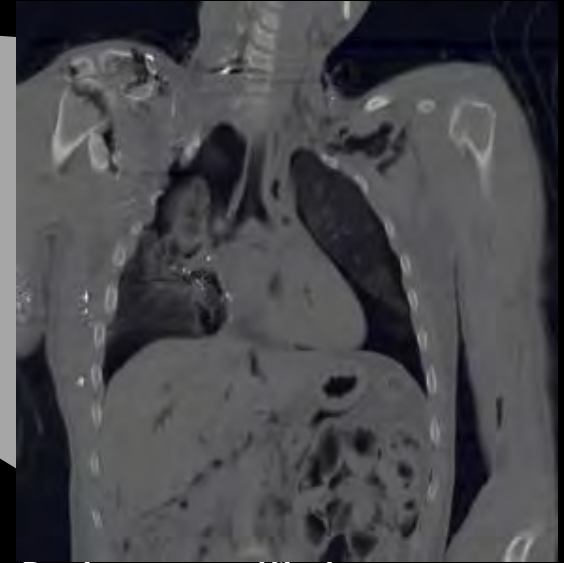
Second Life



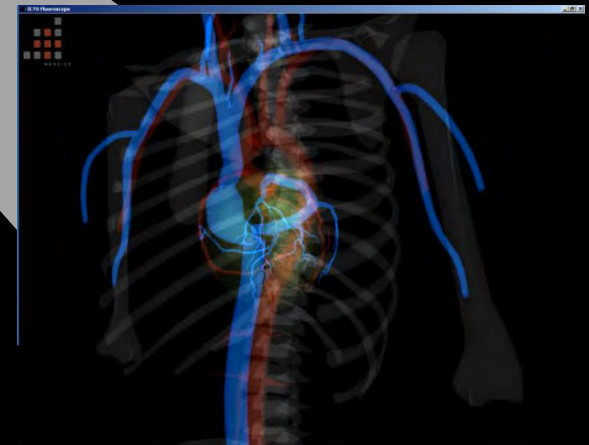
Clinical

Application

Surgical Rehearsal Endovascular Simulators

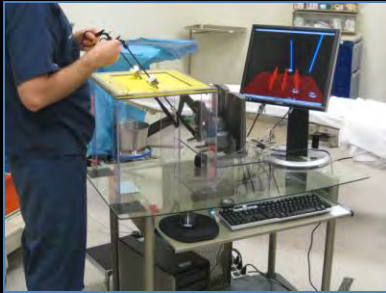


Patient specific image

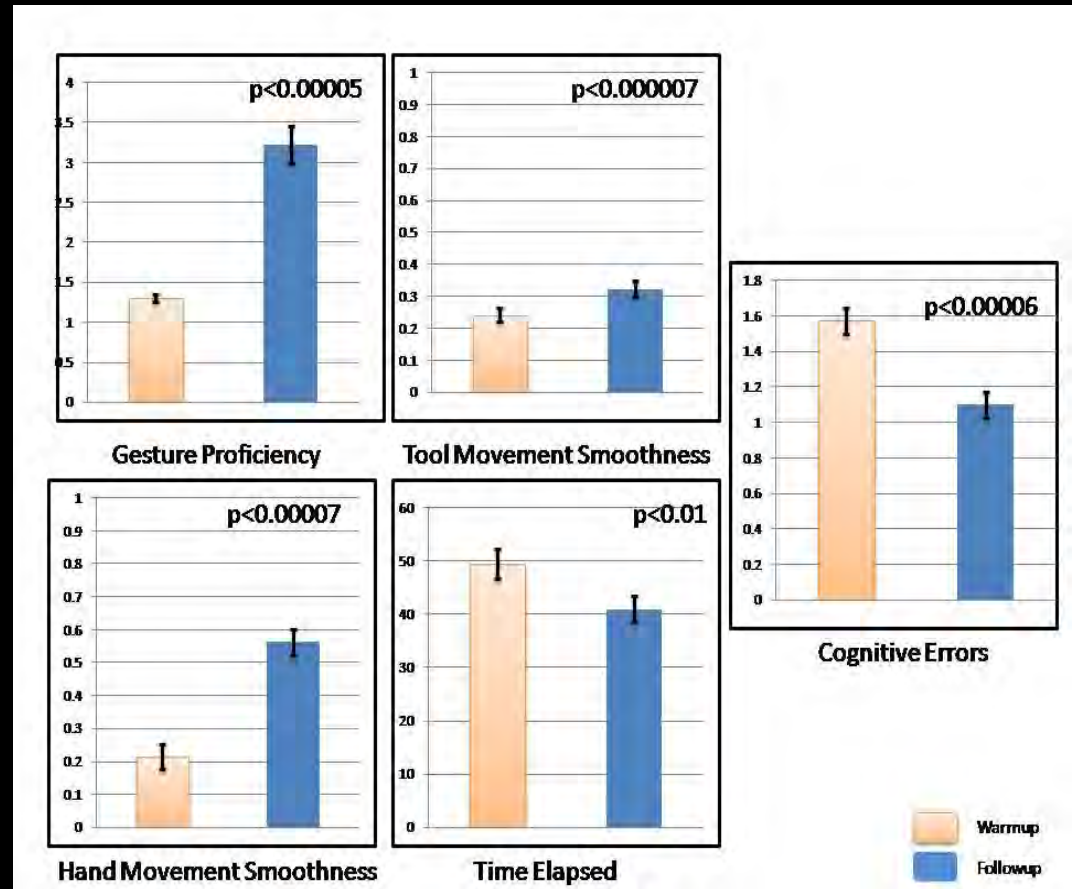
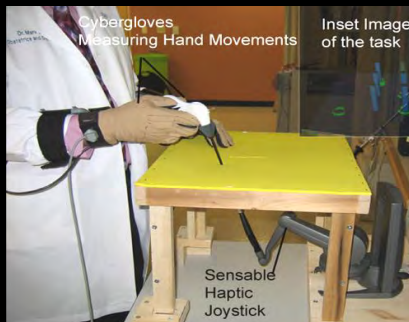
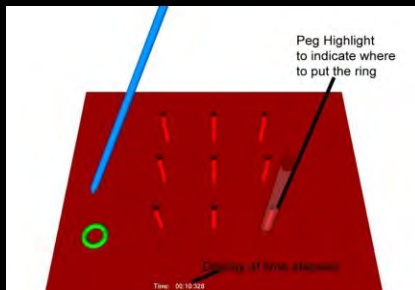


Graphic overlay

Pre-operative Warm-up



Portable Simulator rolled into OR.

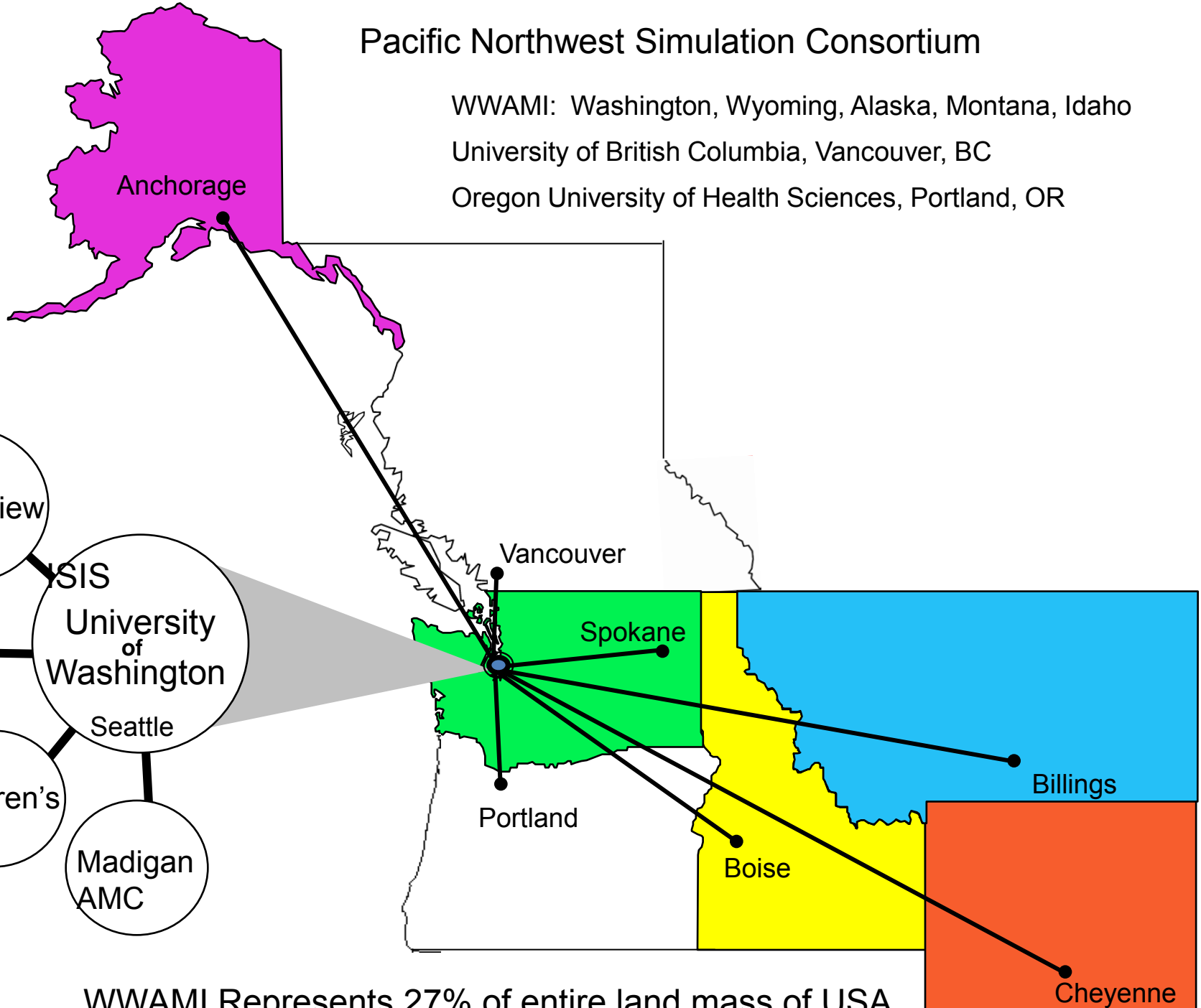


Pacific Northwest Simulation Consortium

WWAMI: Washington, Wyoming, Alaska, Montana, Idaho

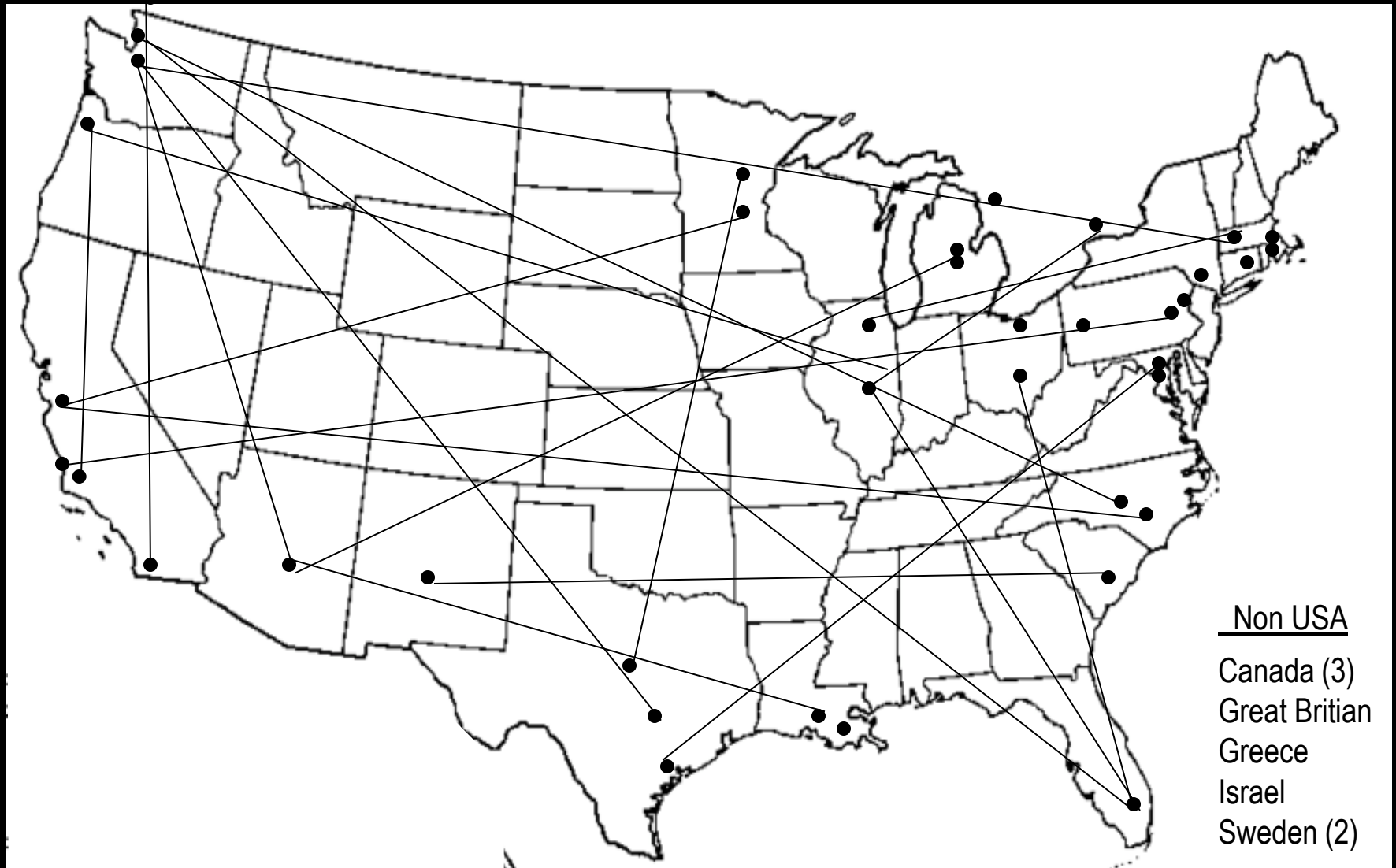
University of British Columbia, Vancouver, BC

Oregon University of Health Sciences, Portland, OR



WWAMI Represents 27% of entire land mass of USA

ACS-AEI Consortium



Comprehensive **C**urriculum

Basic **S**kills

Simple **P**rocedures

Advanced **P**rocedures

Team **T**raining

Task
Deconstruction

Continuity of **C**are

Meeting Legal Requirements and Fiscal

Animal, cadaver & actor replacements



Technology Drivers

Changing Training Requirements

Future types of Simulation	Where used	Competency (assumes all use Knowledge)	Clinical Relevance (assumes all serve Patient Safety)
In Situ Training	Team Training	Systems –based Communication Professionalism	Risk management
Hand off	Team	Communication Professionalism	Patient safety
Choreography	Team Training	Communication Technical Skills	Patient safety
Pre-op Warm up	Clinical Application	Pt care (Technical skills)	Patient safety Risk management
Surgical Rehearsal	Clinical Application	Pt Care (Technical Skills)	Risk management Quality assurance
Cognitive vs Skills	Laboratory Training	Knowledge (Technical skills)	Credentialing
Animal , cadaver & actor replacement	Laboratory Training	All Federal Law	Ethical Issues Cost reduction

Funding for Medical Simulation

TATRC	Congressional Special Interest
DHP	US Army Core Medical
PEO-STRI	US Army Logistics
Veterans Affairs	CoE Medical Simulation - Orlando
AIMS	DHHS (AHRQ) – Multi-agency

Business Model ?

1. Drivers

- a. Mandates
- b. Cost Reduction
 - 1.) Cadaver Lab - av \$800,000 yr
 - 2.) Actor patients - \$250,000 – \$400,000/yr

2. **Digital Libraries** or synthetic tissue models

- a. Subscription vs up-front costs
- b. Virtual cadavers
- c. Virtual actors
- d. Synthetic vs virtual animals (humans)

3. Non-technical skills training

- a. Manikin and hybrid models, virtual actors
- b. Team training, hand-off, communication, professionalism

Will the simulation companies be able to survive?

Enabling Technology

High Performance Computing



and data storage

First hard disk drive in 1956... with **5 MB** of storage. In September 1956, IBM launched the 305 RAMAC, the first 'SUPER' computer with a hard disk drive (HDD). The HDD weighed **over one ton** and stored a 'whopping' **5 MB** of data.

Future **S**imulation and **E**xamination ?



Courtesy : Ivo Broeders, Twente University,
Delph Netherlands 2010

Is this the **REVOLUTION** in Surgical Education?

The Scientific Method

... make evidence-based decisions

Hypothesis



Design



Experiment



Results



Report

In Science and Discovery,
there is always Risk . . .



Be careful of unintended consequences

Experience is the name everyone gives to their mistakes - Oscar Wilde

The only thing more dangerous
than trying too hard and failing ...
... is not trying hard enough

and succeeding ! Michelangelo 1503



National Simulation Initiative

A Nexus of Medical Simulation in Orlando, FL

